FOOD FROM THE OCEANS

by N. K. PANIKKAR*

National Institute of Oceanography, CSIR, New Delhi

Food resources currently utilized from the ocean form only a small fraction of what is available. Even here the fishery wealth is largely exploited from the Atlantic and Pacific Oceans. Indian Ocean resources have only just begun to be exploited and at present accounts only about two million tons out of the world production of about 52 million tons. Increased contribution from the ocean to supply the protein requirements of the people bordering the Indian Ocean is an absolute necessity but this could be achieved only with substantial investments and improvements in fishery technology. The machanization of fishing has taken place in some of the countries but this has to make further headway. Improvements in fishing techniques for species occurring in populations less dense than in temperate waters are called for. The tropical climate emphasizes the need for improved methods of handling and preservation. A good combination of oceanographic research with fish searching operations would be essential for economic yieds. It is estimated that at present there is a deficit of about 4 million tons if we are to consider the requirements of the fish-eating population alone of India and that this deficit will increase substantially with a larger population and more cosmopolitan dietary habits. Although much is being done in the field of fisheries and there are many positive achievements, it is obvious that this important national resource has not received the attention it deserves both as a source of food and as valuable material for export trade.

INTRODUCTION

About 70 per cent of the earth's surface is covered by the oceans. In this vast area living matter is produced on a gigantic scale by the conversion of inorganic materials in the sea into organic living substances by photosynthesis, in several billions of tiny plant organisms with chlorophy 11, utilising the radiant energy of the sun. These billions of plant cells from the starting point of a series of organisms, both plant and animal, small and large, culminating in extremely specialized forms of life like whales. A conservative estimate is that the ocean is producing at least two thousand billion tons per year of organisms which have a size and form so as to be harvested by man with existing or known methods of technology. All these two thousand billion tons need not represent fish but they belong to different trophic levels. When we come to the apex of the food chain in the sea, the present estimate is that at least two hundred million metric tons of fishery resources, i.e., nearly four to five times the present catches, are available to man. Harvesting of this two hundred million metric tons of fish per year from the oceans can be effected with existing technology, without radical innovations in the fish catching technique, but this has to be preceded by extensive oceanographic surveys to

* **Present address : Director, National Institute of Oceanography, CSIR, Panjim, Goa.**

determine the areas of high productivity. This also does not include extensive fish farming of the coastal areas whose possibilities are obviously immense.

As against this let us look at the present production. In 1966 the world food production from the sea was about 48.90 million metric tons, out of the world total aquatic yield including that from the lakes, rivers and fish ponds, estimated at 56.80 million metric tons. The total world catch in 1948 was 19.60 million metric tons and the progressive increase in 1948-1966 for which figures are available, is given in Table I (*See also* Fig. 1). Substantial increase in terms of quantity is possible only from the oceans, but inland fisheries

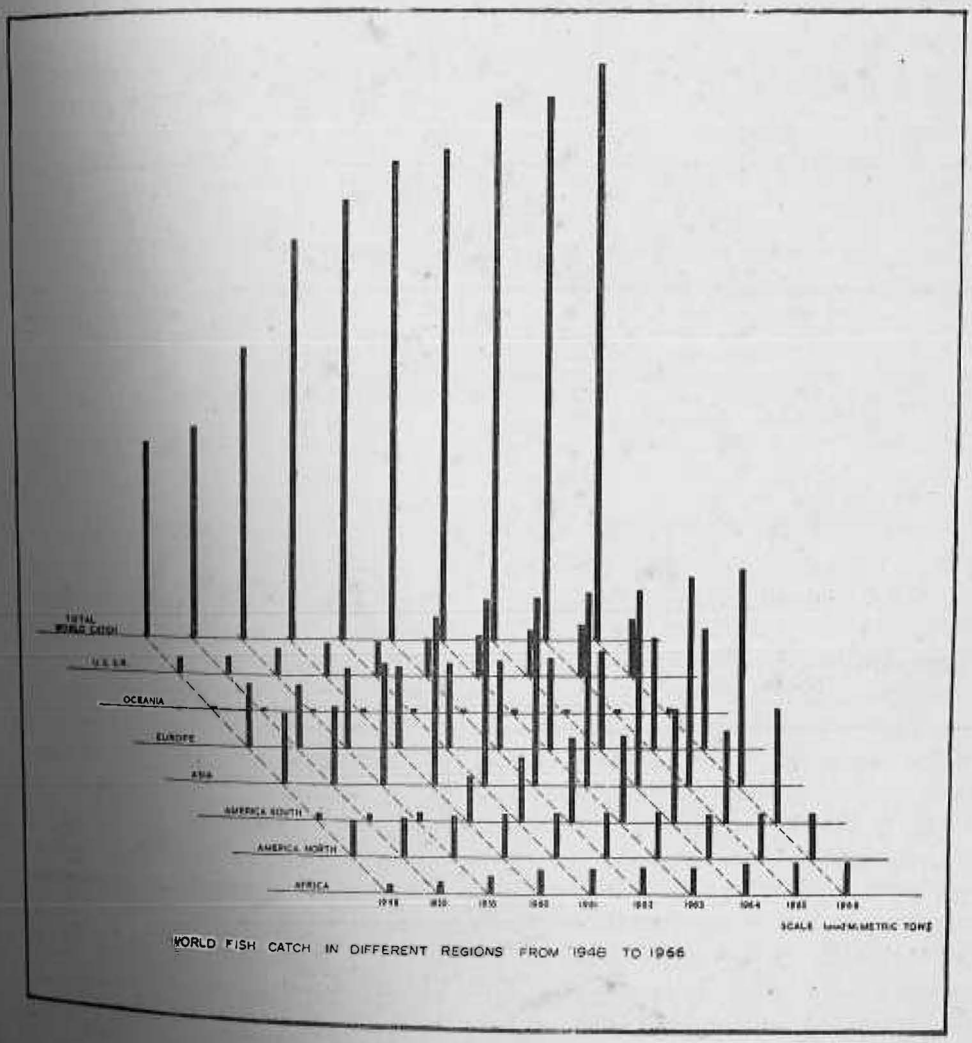

FIG. 1

have high importance in rural economy. The breakup values of the total fish catch for 1966, for the different oceans are given in Table II.

TABLE I*

World fish catch in different regions from 1948 to 1966

(Landings in million metric tons)

	1948	*1950*	*1955*	*1960*	*1961*	*1962*	*1963*	*1964*	*1965*	*1966*
Africa	0.95	1.20	1.83	2.30	2.48	2.64	2.78	3.05	3.09	3.10
America North	3.59	3.78	3.95	4.09	4.33	4.49	4.38	4.30	4.46	4.40
America South	0.48	0.52	0.83	4.43	6.29	8.28	8.42	11.01	9.00	11.08
Asia	6.85	7.67	11.90	17.89	18.55	19.13	19.53	19.82	20.59	21.18
Europe	6.15	6.17	7.84	8.09	8.36	8.64	8.99	9 74	10.86	11.53
Oceania	0.09	0.09	0.10	0.13	0.13	0.14	0.14	0.15	0.16	0.17
U.S.S.R.	1.49	1.63	2.50	3.05	3.25	3.62	3.98	4.48	5.10	5.35
Total	19.60	21.10	28.90	40.00	43.40	46.90	48.20	52.50	53.30	56.81

TABLE II*

Ocean-wise fish catch for 1966 (in million metric tons)

ATLANTIC			
North Western	...	4.1	
North Eastern	...	10.2	
Mediterranean and Black Sea	...	1.1	
Western Central	...	1.3	=20.7
Eastern Central	...	1.4	
South Western	...	0.6	
South Eastern	...	2.0	
PACIFIC			
Northern	...	5.6	
Western Central	...	10.6	
Eastern Central	...	0.6	=27.1
South Western	...	0.2	
South Eastern	...	10.1	
INDIAN OCEAN			
Western	...	1.3	2.2
Eastern	...	0.9	

* Taken from "Yearbook of Fishery Statistics", 1966, FAO, Volume 22.

It will be seen from Table I that a significant increase in production has occurred in Asia, South America and USSR. The Asian picture is not as bright as reflected by the total production because Japan alone produces about seven million tons of fish. The major increase has been in the Northern hemisphere from fishing grounds already well known and exploited. It is clear from these figures that with an overall development in technology and a well planned intensive development, the present fish production from the sea and its utilization could be increased substantially. In the last five years, phenomenal increase in production has been in Peru in South America where the yield from anchovies has risen to unprecedented heights, pushing back Japan, the world's leading fishing nation to second place. The fish caught occupies a lower position in the food cycle in the sea and consequently leads to greater

production without involving loss due to conversion in higher trophic levels. Also surface waters of the West Coast of South America are enriched by upwelled waters on an unprecedented scale.

Nutritional Requirements

The consumption of total animal protein food in kilograms per head per annum is 241 for North America, 226 for Oceania, 141 for Western Europe, 120 for Eastern Europe and USSR, 51 for the Near East, 29 for the Far East and 40 for Africa. Of this fish consumption in kg per head per annum is 5.0 for North America, 4.0 for Oceania, 8.0 for Western Europe, 6.0 for Eastern Europe and USSR, 2.0 for Near East, 5.0 for Far East and 3.0 for Africa. (FAO Third World Food Survey, 1963). Corresponding figure for India is 1.0 kg. Details in respect of recent fish availability per caput per year for different countries are given in Table III.

Table III

Per capita fish supplies available in some countries
(Figures in kg per caput per year)

Country	*1952-53*	*1955-56*	*1958-59*	*1961-62*	*1962-63*
EUROPE					
Denmark	12.6	13.8	15.1	16.1	16.0
Finland	10.4	11.2	11.0	10.5	9.1
Norway	20.2	19.6	17.8	20.2	20.4
Portugal	17.0	17.5	19.7	20.6	20.0
Spain	9.9	10.5	11.2	13.2	14.8
U.K.	9.8	9.9	10.1	9.5	9.2
AMERICA					
Canada	6.2	6.0	6.7	5.6	5.6
U.S.A.	5.1	4.9	4.8	4.8	4.8
ASIA					
Ceylon	5.4	5.1	6.1	6.0	6.2
India	0.9	1.1	1.0	1.0	1.0
Japan	19.5	22.1	24.7	26.6	27.8
Pakistan	1.0	1.6	1.5	1.6	1.6

[redacted]mediate need to augment protein supply in Asia is obvious from these figures. In the Asian countries which are situated around the Indian Ocean this gap can be filled to a considerable extent by obtaining increased food supply, particularly fish from the oceans and to some extent from inland water resources. This is supported by the knowledge that the sea can be quite productive in many regions of the world. It is estimated for example that from an acre of sea water an annual yield of 1 to 3 tons of dried organic matter can be obtained (Finn 1960).

Fish Requirement for Balanced Diet

The composition of a balanced diet suitable for a normal adult male to give an approximate nutritive value at 3,000 calories per day would consist

of 90 g of proteins, 450 g of carbohydrates and 90 g of fat.-The protein requirement in a balanced diet is met by 10 oz (284 g) of milk and milk products and 3 oz (85 g) of fish and meat along with 1½ oz (40 g) from eggs (one egg). These have been worked out on the basis of a diet which is predominently based on cereals (which is the food pattern in most Asian countries) at 14 oz (400 g) per day, with 3 oz (85 g) of pulses, nuts and oilseeds. Table IV gives the schedule as approved for India.

TABLE IV

Composition of balanced diet

Class of food	*Quantity (oz)*	*Quantity (g)*
Cereals	14	400
Pulses, nuts and oilseeds	3	85
Green leafy vegetables	4	114
Root vegetables	3	85
Other vegetables	3	85
Fruits	3	85
Milk and milk products	10	284
Sugar and jaggery	2	57
Vegetable oil, *ghee*, etc.	2	57
Fish and meat	3	85
Eggs	1½ (one egg)	40

It may be seen from the Table that milk products have been shown as the main components of protein, but the per capita output of milk is extremely small in most of the Asian countries. Likewise, meat is expensive and both milk and meat contribute to further pressure on land. For the average income group cheap fish would compensate to some extent the reduction in meat and milk. As recommended by the Indian Nutrition Advisory Committee (Aykroyd *et al.* 1963), for calculation purpose, the requirements may be put down at about 3 oz (85 g) of fish per head per day as the essential protein requirement from fish for people who consume fish.

On the basis that about 60 per cent of the people in India would accept fish, and 100 per cent in all other Asian countries around Indian Ocean, the total requirements of fish for the Asian countries of the Indian Ocean will be of the order of 12 million metric tons. The present population and minimum fish requirement for Asian countries (as for 1965) and projected population and requirement of fish for the year 2000 A.D. are given by Panikkar and Dwivedi (1966). At present there is a deficit of approximately 10.5 million tons of fish even to fulfil the minimum fish requirements for a balanced diet.

According to a basic study made in connection with the Freedom from Hunger Campaign, organized by FAO the total population in Asia and the Far-East by 2000 A.D. will be of the order of 3,639 million. This presupposes an increase in the total food available by about four times from the base value in 1958. Approximately only a third of the population figure given above concern the countries discussed in this paper on the basis of 1965 figures. At 2400 calories per caput per day the total protein requirement is of the order

of 75 g per day of which 20 g at least must come from animal products. Assuming that half of this will be available from milk and animal products, at least 10 g must come from fish per caput per day. On the 10 g basis, the total requirement of fish in the Asian countries discussed in this Paper is of the order of 2.14 million metric tons as against the present production of 1.5 million metric tons. This requirement is, however, on the low side because in most countries of Asia, milk and meat are expensive and beyond the reach of a large section of the population. It would thus be safer to proceed on the basis of 20 g fish per caput requirement.

So far as India is concerned, the scope for increasing food supplies from the sea is very substantial. In fact, this is absolutely necessary. Based on our nutritional requirements for the fish eating people of the country alone (60-65 per cent of the total), we would need today something like 5 million tons of fish. As against this, the present fish production is only about 1.2 million tons. The marine fish landings in India, at present, are of the order of 0.8 million metric tons, and are soon expected to touch the million ton mark. The fisheries potentialities of the Bay of Bengal and Arabian Sea are different (Panikkar and Jayaraman 1966). The Arabian Sea accounts for more than 75 per cent of the total fish catch in India. The major components of Indian fisheries are the various types of sardines, Indian mackerels and the prawns and these also offer extensive possibilities for increased catch. The anomaly in our production is that the catch per fisherman is extremely small owing to the high-scattered nature of the fishing communities and the very primitive methods of fishing. Catch per fisherman in India is probably the lowest in the world. The Indian Ocean at present yields something like two to two-and-a-half million tons of fish and our calculations are that this yield could be increased by at least ten times but this pre-supposes certain substantial changes in the industry. A beginning towards these changes has already been made and a considerable amount of success has been achieved but all this is small as compared with our needs. During the past ten years mechanization of fishing by the introduction of power boats has increased a great deal, refrigeration and processing facilities have developed, packing industries have been established, rail and road transport for fish have been improved and an export sector has been prominently developed for prawns. In spite of all these positive achievements it is obvious that this important national resource has not received the attention it deserves, both as a source of food and as an important material for commerce.

Oceanography

Like the land, oceans include both fertile, less-fertile and sterile regions. One of the objects of oceanographic investigations is to diagnose these areas which are promising and this can be done by measurements of physical and chemical properties of the sea, followed by biological investigations. Such an effort has been made in a preliminary way during the International Indian Ocean Expedition during the years 1961 to 1965 and we have now a fairly good

first picture of the areas which are productive in the Indian Ocean. Some of these compare well with the best known fishing grounds of the world. The southwest coast of India, Gulf of Aden, the Gulf of Oman, Andaman Sea are some of the areas with great potentialities (Panikkar 1969). The importance of these findings is noteworthy because the older concept was that tropical areas are generally unfavourable for the establishment of large-scale marine fisheries. It is now fairly well established that systematic pursuit of areas of divergence and upwelling and their seasonal changes will enable us to obtain much better yields from tropical oceans. Substantially increased catches are possible from fisheries for sardines, mackerel, tuna, prawns and various percoids. The Indian production can be raised reasonably to ten times the present level provided all ancillary facilities to fishing are developed in an integrated manner. With substantial increase in catches there is scope for newer technology and the manufacture of products such as fish protein concentrates.

References

Aykroyd, W.R., Balasubramanian, S.C., and Gopalan, C. (1963). Sp. Rep. Ser. No. 42, *Indian Coun. med. Res., New Delhi.*

FAO, Rome (1962). *Rep. Int. Confr. Fish Nutr. Fish. Rep. No.* 1.

FAO, Rome (1966). Yearbook of Fishery Statistics, 22.

FAO, Rome (1963). Third World Food Survey, F.F.H.C. Basic Study, No. 11.

Finn, D.B. (1960). World Food Problems, No. 3. FAO, Rome.

Panikkar, N.K. (1966). Fishery Resources of the Indian Ocean. *Bull. natn. Inst. Sci. India*, No. 38, Part II.

Panikkar, N.K., and Dwivedi, S.N. (1966). Fisheries of the Asian Countries Bordering the Indian Ocean. Proceedings of the Seventh International Congress of Nutrition, Hamburg, 4.

Panikkar, N.K., and Jayaraman, R.(1967). Biological and Oceanographic Differences between the Arabian Sea and the Bay of Bengal as observed from the Indian region. *Proc. Indian Acad. Sci.*, **64**.